

ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM

SURFACE WATERS FIELD OPERATIONS MANUAL FOR LAKES

The information in this Adobe Acrobat Reader PDF file is one of several PDF files extracted from this report. The PDF files from the report are:

lake_ove.pdf	Overview of EMAP Surface Waters Lake Sampling, daily operations, lake verification and index site location, and general lake assessment (Sections 1, 2, 3, 4, 9)
lake_hab.pdf	Protocols for temperature, dissolved oxygen, shoreline physical habitat (Section 5)
lake_fis.pdf	Protocols for fish sampling (Section 6)
lake_wat.pdf	Protocols for Secchi transparency, water sample collection, chlorophyll a, zooplankton, sediment diatom (Section 7)
lake_ben.pdf	Protocols for benthic invertebrate sampling (Section 8)
lake_avi.pdf	Protocols for avian assemblages (Appendix A)
lake_vis.pdf	Lake-Visit Checklists for all Field Measurements (Appendix B)
field_fo.pdf	Field Data Forms for all Field Measurements (Appendix C)

The Table of Contents, acknowledgments, notice page, listing of figures, listing of tables, and listing of acronyms for the document appear at the end of each pdf file.

In all cases, the source for this information for citation purposes is:

Baker, John R., David V. Peck, and Donna W. Sutton (editors). 1997. Environmental Monitoring and Assessment Program Surface Waters: Field Operations Manual for Lakes.
EPA/620/R-97/001. U.S. Environmental Protection Agency, Washington D.C.

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ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM SURFACE WATERS

FIELD OPERATIONS MANUAL FOR LAKES

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Contract No. 68-C0-0049

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ABSTRACT

The methods and instructions for field operations presented in this manual for lake surveys were developed and tested through 4 years of pilot and demonstration projects from 1991 through 1994. These projects were conducted under the sponsorship of the U.S. Environmental Protection Agency and its collaborators through the Environmental Monitoring and Assessment Program (EMAP). This program focuses on evaluating ecological conditions on regional and national scales. This document describes procedures for collecting data, samples, and information about biotic assemblages, environmental measures, or attributes of indicators of lake ecosystem condition. The procedures presented in this manual were developed based on standard or accepted methods, modified as necessary to adapt them to EMAP sampling requirements. In addition to methodology, additional information on data management and other logistical aspects is integrated into the procedures and overall operational scenario. Procedures are described for collecting chlorophyll *a*, water, sedimentary diatoms, and zooplankton data in conjunction with the development of standard methods to obtain acceptable index samples for macrobenthos, fish assemblage, fish tissue contaminants, riparian birds, and physical habitat structure. The manual describes field implementation of these methods and the logistical foundation constructed during field projects. The manual includes flow charts with overall summaries of specific field activities required to visit a lake site and collect data for these indicators. Tables give step-by-step protocol instructions. These figures and tables can be extracted and bound separately to make a convenient quick field reference for field teams. The manual also includes example field data forms for recording measurements and observations made in the field and sample tracking information. Checklists of all supplies and equipment needed for each field task are included to help ensure that these materials are available when required.

APPENDIX A

AVIAN INDICATOR FIELD OPERATIONS MANUAL

Data on bird assemblages were collected by different crews on separate visits than those who collected data for other indicators. A separate field operations manual was developed specifically for the avian indicator. The manual included in this appendix has been re-formatted and re-organized from the original to be consistent with the rest of the EMAP-SW lakes field operations manual. However, no revisions to the technical content have been made by the editors.

FIELD OPERATIONS MANUAL- BIRDS

1994

by

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1.0 OVERVIEW

Personnel from the Wildlife Department at the University of Maine have been contracted by the Environmental Protection Agency (EPA) to determine whether birds can serve as indicators of the biotic integrity of lakes and ponds in New England, New York, and New Jersey. The following document discusses operations necessary to complete the fieldwork.

1.1 Participating Organizations and Responsibilities

Cooperators on this project include personnel from the EPA's Environmental Monitoring and Assessment Program (EMAP), ManTech Environmental Technology, Inc. (METI), Lockheed Engineering and Sciences Company (LESC), and the University of Maine, Orono campus (UMO). EMAP, METI, and LESC work together to provide UMO with logistics information about the lakes to be surveyed. From here on, we will use the term EMAP to include personnel from EMAP, METI, and LESC. EMAP will provide UMO with a list of the lakes to be surveyed (including latitude, longitude, and size of each lake), landowner permission forms, outlines (to scale) of the lakes, any available directions to the lakes and other logistic information. The list of lakes to be surveyed should be provided to UMO prior to March 15, 1994 so UMO can have enough time to plan fieldwork. EMAP will secure permission for UMO to access those lakes.

UMO is responsible for ensuring that fieldwork is completed according to the strict protocols designed for this project, which will be discussed in Section 4. UMO will provide EMAP with photocopies of all data sheets after the fieldwork is completed. After data is entered and error checked, UMO will send an electronic copy of the data to EMAP.

1.2 Field Personnel, Training, and Quality Assurance

It is anticipated that fieldwork for the 1994 season will require at least five crews. Each crew consists of two people, one person to record habitat data, the other to record bird information. The bird surveyor will be the more experienced field person and will serve as crew leader. Personnel hired for habitat and bird data collection will be trained during April and May 1994. Training will involve going out in the field daily to practice bird censusing and habitat identification on land, as well as implementing the censusing protocols on lakes. Bird surveyors will be required to demonstrate at least a 90% proficiency on a Quality Assurance (QA) test of bird identification skills administered by Norm Famous, QA officer. This test will consist of taped bird calls likely to be encountered in the region the surveyor will be working. Additionally, censusers will be tested on bird identifications in the field using the protocols that will be

followed during fieldwork. Habitat personnel will be tested by having them simultaneously assess habitats in sample census plots. This will allow us to examine how variable estimates are among crews.

One mid-season QA test will be administered by an experienced ornithologist to each crew during an actual survey in mid-June. Each surveyor will be required to have at least a 90% overlap with the species identified by the ornithologist. Habitat personnel will not be required to take a mid-season QA test, but by going out with each crew, the ornithologist will be able to assess whether field personnel differ greatly in their estimations.

1.3 Sampling Schedule - 1994

All lakes will be surveyed during May 28-July 7, 1994. Lakes in the southern region (e.g., New York, New Jersey) will be surveyed earlier in that period than those in northern areas (e.g., Maine).

2.0 DAILY OPERATIONS

Each crew will pre-survey the lake the evening before the actual census to determine if any problems will be encountered in the morning. If the lake is large (>4800 m perimeter), then crews will need to map the habitat types in the evening and stratify census plot locations according to those habitat types. Crews may also wish to record habitat data during the evening pre-survey to save time in the morning. If all of the lakeshore can be seen from land, then it is unnecessary to go out on the water during the pre-survey.

Crews will arrive at the lake an hour before sunrise so that they can start the survey one-half hour before sunrise. An equipment checklist will be completed before launching the canoe to begin the survey (Figure A-1). The survey will be completed by four hours after sunrise or when one circuit around the lake has been completed, whichever is shorter.

After the survey, crews will check all data sheets to make sure everything is filled out appropriately. Crews will then travel to the next lake, find a place to stay, and conduct a pre-survey.

Crews will be required to phone UMO every day and report on their progress. Every third day, crews will photocopy data sheets and mail them to UMO.

3.0 LAKE LOCATION AND VERIFICATION

In general, each crew will be responsible for surveying 20 lakes. Prior to the field season each crew will be provided with maps of their assigned lakes. In the field, each lake will initially be located based on topographic maps or road atlases. Crews will then check whether the map of the outline of the lake provided by EMAP matches the actual outline. Verification can also be checked by asking people in the area to identify the lake.

Quantity	Item	
2 pr.	Field glasses	
2	Field notebook (waterproof surveyor's notebook)	
2	Clipboard (2)	
30	Field recording forms	
5	Large ziplock bag (5)	
1 ea.	Maps of lake (topographic and sketch)	
1	Tape recorder	
6	Extra batteries (size D)	
1	Tape with wetland bird songs	
4	Ballpoint pens	
4	B pencils (for use if recording forms become damp)	
1	Compass with clinometer	
1	Thermometer	
1	Stopwatch	
1	Habitat analysis protocol	
1	Bird census protocol	
1	canoe	
1	outboard motor fuel tank (full) bailer	
3	paddles (including 1 spare)	
2	type IV life preservers	
1	first aid kit	
1	fire extinguisher	
1-2	anchor(s) and rope(s)	
DATE:		OBSERVER:

Figure A-1. Equipment checklist for lake survey field crews.

Crews will determine if the lake meets the EMAP criteria (i.e., ≥ 1 ha in total surface area, ≥ 100 square meters of open water, and ≥ 1 m in depth). Any lake that does not match these criteria will be designated as a "non-target" lake and will not be surveyed. EMAP will be notified of any "non-target" lakes so that substitutes can be chosen.

4.0 DATA COLLECTION

Crews will survey both shoreline habitat and birds in a circular plot with a 200 m diameter (Figure A-2). Plots will be established every 200 m on lakes with a perimeter ≤ 4800 m, starting 200 m from the boat ramp (or put in, if no ramp is present) in a clockwise direction until one circuit around the lake is completed. If fewer than 6 census points can be fit on the lake during the first circuit, then the number of points will be determined according the protocol listed in Table A-1. On lakes with a perimeter larger than 4800 m the maximum number of census plots will be 24 and the minimum will be 20. Location of these points will be stratified according the occurrence of major habitat types (Table A-2).

Location of all census plots will be recorded on the map outlines and a description of the census point will be recorded in a field notebook by the crew leader.

4.1 Bird Data

Bird data must be collected between one-half hour before and four hours after sunrise on days that meet the required weather conditions (item 3, Table A-3). All birds seen and heard during five minutes will be recorded according to the protocol (Table A-3). Birds will be identified to the species level. If the surveyor does not see or hear the bird well enough to identify it to the species level, it will be identified to the lowest taxonomic level possible (e.g., genus, family). The method of identification (i.e., visual or aural), location of the bird (e.g., within 100 m, in the air, in the water, or on land), and the number of individuals will be recorded as well (Figure A-3).

4.2 Habitat Data

Habitat data will be taken during the five minutes spent at each census station (figures A-4 and A-5). The percent cover of several habitat types will be estimated by quarter in the census plot. Habitat types are defined in the protocol for the recording of habitat data (tables A-4 and A-5). In forested habitats, the two dominant tree species will be recorded. Presence of people, boats, houses, and snags will also be noted. Weather information (cloud cover, temperature, wind) will also be taken by the habitat data recorder (Table A-6).

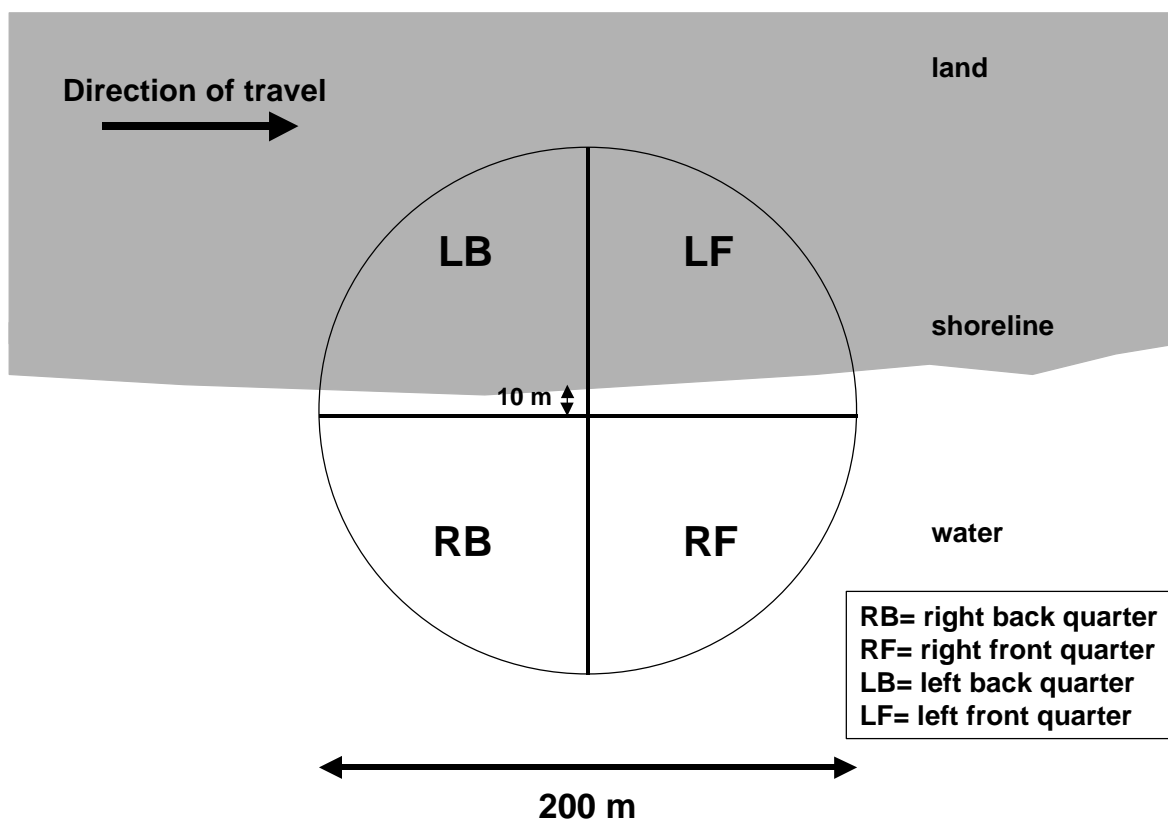


Figure A-2. Census plot design.

TABLE A-1. PROTOCOL FOR THE NUMBER OF STOPS TO BE CENSUSED

If the lake is larger than 4800 m you will need to allocate the number of stops based on percent of each habitat type listed on the 'habitats to stratify on' sheet that I gave you earlier. When you allocate stops in a particular habitat start 200 m inside that habitat type. If the habitat type is equal to 200 m then put the stop in the middle. If the habitat type is less than 200 m of the shoreline, do not count it as a separate habitat type.

For the small lakes, start 200 m in a clockwise direction from the boat ramp. If six or greater stops can be fit on the first trip around the lake, do only 1 circuit. If only 3-5 stops can be fit, then go around one more time (doing the same stops over again). If only 1-2 stops fit on the lake, continue sampling until you complete 6 stops. For the 2-stop lake that would mean going to the same stops three times. For the 1-stop lake, you will do the same stop six times. Wait 5 mins. between each census.

TABLE A-2. HABITAT TYPES ON WHICH TO STRATIFY PLOT LOCATIONS

Habitat type	Categories on habitat form which are included in the major habitat type
Marsh	tall and short marsh, wet grassland
Bog	low shrub swamp types
Tall shrub swamp	tall shrub swamp
Low shrub swamp	low shrub swamp
Wooded swamp Deciduous Mixed Coniferous	all height and canopy closure classes for these three wooded swamp types
Upland Forest Deciduous Mixed Coniferous	all height and canopy closure classes for these three upland forest types
Agricultural	croplands (grain and vegetable), pasture, hayfield, orchard
Transitional	clear cuts, old-field (grass and shrub)
Urban	urban
Forested suburban	forested suburban
New suburban	new suburban
Old suburban	old suburban
Transportation/ Communication	transportation/communication

Note: the four housing types (urban, suburban, old and new suburban) may need to be combined if separately they do not account for enough of the shoreline to be sampled.

TABLE A-3. PROTOCOL FOR SURVEYING BIRDS

1. Lakes will be visited generally from a south to north direction, thereby taking advantage of any seasonality present in bird behavior. Logistical factors may make it expedient not to follow the south to north sequence rigorously.
2. Whenever possible, crews will visit each lake immediately prior to the first census (typically by visiting it the previous evening), to review the habitat present and to confirm that no special problems will be encountered there.
3. Surveys will be conducted from 0.5 hour before sunrise to 4 hours after sunrise on days with good visibility, and minimal precipitation and wind, following the guidelines of the USFWS BBS. Wind speed will be measured on the Beaufort scale (a 3 or less indicates acceptable conditions); Sky conditions will be noted using Weather Bureau codes. Light fog and rain will be considered acceptable if they are not persistent. If 50% of the census points have sub-standard weather conditions the lake will be surveyed again.
4. Each field crew will use a motorized canoe to follow a transect parallel to 10 m from the lake shore. The direction of travel will be clockwise around the lake unless the crew decides that it is prudent to follow a different course (e.g., in order to avoid obstacles or take advantage of wind conditions). The direction of travel for the second visit will be the same as during the first visit, even if the first circuit was traveled counterclockwise. At each observation point the motor will be shut off and birds seen or heard during a 5-minute period will be noted. Numbers of all birds seen or heard will be recorded in ink or with a letter B pencil on a standard survey form. Observers will distinguish individuals seen:
 - flying overhead vs. on the water vs. on land
 - between observation points vs. at observation points
 - within 100 m of points vs. more than 100 m; for the distant registrations the stop to which they are closest will be recorded
 - from birds heard (though both categories will be recorded)
5. When habitats which normally host typically secretive marsh birds (e.g., bitterns) are present, observers will play a standardized tape recording of the calls of these species, to increase their detection. Thirty seconds of calls for each of the following species will be played: Pied-billed Grebe, Sora, Virginia Rail, American Bittern, American Coot, Common Moorhen, and the Yellow Rail. The taped calls will be played immediately preceding the 5-minute census period.
6. Census points will be 200 m apart, with distance between points judged using a range finder. Each lake will have a minimum of 3 and a maximum of 24 census points. On small lakes, the number of stops censused will be based on the number that can be fitted (200 m apart) in the first circuit around the lake. On large lakes where the perimeter exceeds 4800 m so that more than 24 points could be accommodated, the 24 points censused will be stratified by habitats present. The amount of each habitat will be measured using map wheels to quantify the amount of each habitat present based on the evening pre-survey. Census points will be allocated according to the percent of each habitat type found along the shore. The exact location of census points will be based on distance from launch site (preference given to those closest) and will begin 200 m from the closest edge of a habitat type. If the amount of habitat is between 200 and 400 m, then the census point will be located in the middle of it to allow all of the census point to cover that habitat type. If less than 200 m of a particular habitat are present then it will not be considered a separate habitat type and will not be allocated any census points. If a habitat type is greater than 200 m, but comprises less than 1/24 of the perimeter of the lake it will still be allocated a census point.
7. The position of each census point will be marked on a map of the lake. This map should contain sufficient detail with respect to landmarks to allow the census points be identified in later visits.
8. The equipment required by each team is listed in Figure 1. The list will be checked daily.

WEATHER

100. TEMPERATURE (⁰C): _____

101. WIND (circle one)

Beaufort No.:	Indicators:
0	smoke rises vertically
1	wind direction shown by smoke drift
2	wind felt on face; leaves rustle
3	leaves, small twigs in constant motion; light flag extended
4	raises dust and loose paper; small branches are moved
5	small trees in sway; white caps on lakes

102. SKY (circle one)

Sky code:	Description:
0	clear of few clouds
1	partly cloudy (scattered) or variable sky
2	cloudy (broken) or overcast
4	fog or smoke
5	drizzle
8	showers

HABITAT ELEMENTS

103. Number of visible boats containing people on water: _____

104. Number of camps and homes within 100 m: _____

105. Number of people within 100 m: _____

106. Islands present within 100 m? _____

107. Dead/dying trees >10 cm DBH present within 5m of or in wetland? _____

108. conifer type: (circle one)

white/red/pitch/jack Pine red/black/white Spruce Fir

Larch Hemlock White cedar Other: _____

109. Hardwood type: (circle one)

red/silver/sugar Maple red/white/scrub Oak

quaking/balsam/bigtooth Aspen white/yellow Birch Beech

Other: _____

110. Comments: _____

FORM

UMNEBP / SDF6B-05-01-92

Figure A-4. Data sheet used to collect habitat information.

LAKESHORE HABITAT SURVEY FORM

1. Observer _____ 2. Lake _____ 3. State _____ 4. Date ____/____/____ 5. Stop ____ 6. Time ____
mm/dd/yy

NON-FOREST	Quarter (cover code)			
	RF	RB	LB	LF
9. Transport / Comm				
10. Hayfield				
11. Pasture				
12. Old field-grass				
13. Old field-shrub				
14. Cropland-vegetables				
15. Cropland-grains				
16. Orchard				
17. New suburban				
18. Forested suburban				
19. Old suburban				
20. Urban				
21. Non-vegetated				
22. Other terrestrial				
26. Lake / pond				
28. Wet grasslands				
29. Low marsh				
30. Tall marsh				
31. Low shrub swamp				
32. Tall shrub swamp				

HABITAT ELEMENTS (present=1, absent=blank)				
33. Stream				
34. Bridge				
35. Cliff				
36. Sand bank				
37. Farm buildings				
38. Wet road ditches				
39. Isolated trees				
40. Clear cutting				
41. Selective cutting				

COVER CODES: blank = ≤5%, 1 = >5 - 25%,
2 = >25 - 50%, 3 = >50 - 75%, 4 = >75%
FOREST CATEGORY: Deciduous = >75% deciduous,
Mixed = <75% decid. & <75% conif., Coniferous = >75% conif.

FOREST	UPLAND FOREST				WOODED SWAMP					
	CLOSURE	TYPE	HT.	Quarter (cover code)						
				RF	RB	LB	LF			
CLOSED (>60% closure)	42.	Deciduous	<5m				43.			
	44.		5-15m				45.			
	46.		>15m				47.			
	48.	Mixed	<5m				49.			
	50.		5-15m				51.			
	52.		>15m				53.			
	54.	Coniferous	<5m				55.			
	56.		5-15m				57.			
	58.		>15m				59.			
	60.	OPEN	Deciduous	<5m				61.		
OPEN (<20% closure)	62.		5-15m				63.			
	64.		>15m				65.			
	66.	Mixed	<5m				67.			
	68.		5-15m				69.			
	70.		>15m				71.			
	72.	Coniferous	<5m				73.			
	74.		5-15m				75.			
	76.		>15m				77.			
	78.	MIDDLE	Deciduous	<5m				79.		
	MIDDLE (20 - 60% closure)	80.		5-15m				81.		
82.			>15m				83.			
84.		Mixed	<5m				85.			
86.			5-15m				87.			
88.			>15m				89.			
90.		Coniferous	<5m				91.			
92.			5-15m				93.			
94.			>15m				95.			

FOREST UNDERSTORY (cover code)				RF	RB	LB	LF
96. Shrub cover							
97. Herb cover							
LOW SHRUB SWAMP Type (cover code)				RF	RB	LB	LF
98. Ericaceous shrub							
99. Sphagnum-mat bog shrub							

FORM UMNEBP/SDF6A-04-29-92

Figure A-5. Lakeshore Habitat Survey Form.

TABLE A-4. PROTOCOL FOR HABITAT DATA COLLECTION.

1. Habitats will be surveyed at each bird census stop. Habitat assessment should be completed within the five minutes spent at each stop.
2. The available cover types will be classified into 91 habitat categories, which are described in Table A-5. The sample are includes the four quarters of a circle with a 100 m radius. Quarters will be defined by a line parallel to the shoreline adjacent to the stop and a line perpendicular to the parallel line. When the stop is located at a bend in the shoreline, the perpendicular line will be perpendicular to the forward direction of travel. The 100 m radius will be estimated using a range finder.
3. Percent cover of each cover type will be estimated within each quarter of the circle. The amount of a cover type will be assigned to one of five categories: blank= 0 to 5%, 1= > 5 to 25%, 2= > 25 to 50%, 3= > 50 to 75%, and 4= > 75%. In forested habitats, the two dominant tree species will be listed. The presence of habitat elements, such as streams, cliffs, houses, snags, boats, and farm buildings, within the census plot will be recorded.
4. Weather data including temperature (Celsius, measured with a thermometer), wind (Beaufort scale, Table A-6), and sky conditions (Table A-6) will be taken at all stops.

TABLE A-5. DEFINITION OF HABITAT TYPES

Habitat Type	Definition
<u>Terrestrial Systems</u>	
Cropland - grains	tilled agricultural land planted in grains (e.g., corn, wheat, barley).
Cropland - vegetable	tilled agricultural land planted in vegetable crops (e.g., broccoli, potatoes, tomatoes).
Pasture	grazed grasslands, usually too wet or rocky for cultivation or haying; grass is dominant in the long-term.
Hayfield	mowed grasslands where grass is dominant in the long-term; this can include extensive, mowed road verges and mowed areas at airports.
Orchard	fruit or Christmas trees < 5 m tall with grassy ground cover.
Old field - grassland	abandoned agricultural fields reverting to forest, characterized by $\geq 75\%$ of grass cover, < 25% shrubs, and small trees (< 2 m).
Old field - shrub	abandoned agricultural fields reverting to forest, characterized by < 75% grasses, $\geq 25\%$ shrubs, and small trees (< 2 m); this can include power line right-of-ways.
New suburban	areas with extensive low-cut grass and few trees, which are < 10 m tall, or have $\leq 20\%$ canopy closure; this can include athletic fields, lawns, cemeteries, golf courses, and tract housing.
Old suburban	areas with extensive low-cut grass and few trees, which are ≥ 10 m tall and have > 20% canopy closure; this includes older cemeteries and parks, and suburban areas with large trees.
Forested suburban	houses in small, forest openings surrounded by pre-existing forest.
Urban	greatly developed areas with large buildings and parking lots.
Non-vegetated	non-urban areas lacking vegetation; this includes gravel and dirt pits.
Transportation/ communication	areas used for transportation or communication; this includes airport runways, roads, railroads, and boat ramps.
Upland forest	upland forested habitats will be broken down by three qualities: type, height, and canopy closure. Type refers to the canopy type (i.e., deciduous, mixed, coniferous). Deciduous forests have $\geq 75\%$ deciduous trees, coniferous forests have $\geq 75\%$ coniferous trees, and the mixed forest type has < 75% conifers and < 75% deciduous trees. Height categories will be < 5 m, 5 to 15 m, and > 15 m tall. canopy closure will be placed into three categories: open (< 20% closure), middle (20 to 60% closure), and closed (> 60% closure). This results in $3 \times 3 \times 3 = 27$ possible types of forest.
Other	miscellaneous and rare terrestrial habitats.

(Continued)

TABLE A-5 (continued)

Habitat Type	Definition
<u>Aquatic Systems</u>	
Wooded swamp	forested areas that are inundated by water seasonally or all year; wooded swamps will be described using the same 27 types discussed under upland forest habitats.
Tall shrub swamp	dominated ($\geq 75\%$ cover) by woody plants 1 to 5 m tall where soils are inundated by water much of the year; this generally includes alder swamps.
Low shrub swamp	woody plants < 1 m tall dominate ($\geq 75\%$ cover); soils are inundated by water much of the year.
sphagnum-mat bog	woody plants ≥ 1 m tall common, but $< 75\%$ cover, and sphagnum mats $\geq 25\%$ of cover; soils inundated by water much of the year.
Wet grasslands	areas dominated by non- <i>Spartina</i> sedges, grasses, and rushes ≤ 1 m tall; soils are inundated with water in the winter and early spring, and saturated in the summer.
Tall marsh	wet areas vegetated with persistent emergents > 1 m tall, $\leq 50\%$ open water; this includes cattail and reed marshes.
Low marsh	shallow water vegetated with herbaceous broad-leaved emergent plants ≤ 1 m tall, $\leq 50\%$ open water; this includes areas with pickerel weed and lily pads.
Lake/pond	permanent bodies of fresh water ≥ 1 ha in size; this includes the parts of the lake/pond that are located within the census plot.
<u>Habitat Elements:</u>	
Stream	permanent or intermittent flowing bodies of water < 3 m wide.
Bridge	a structure elevated > 1 m over land or water and > 5 m long.
Cliff	rocky outcroppings > 5 m tall.
Sand bank	sandy, abrupt drop-off > 5 m tall.
Farm buildings	barns and storage sheds used for agricultural purposes.
Wet road ditches	ditches along the road that have > 10 m long section of persistent emergent vegetation (e.g., cattails, tall reeds).
Isolated trees	isolated single or group of trees in croplands, hayfields, pasture, and reverting fields that do not register as forest.
Clear cutting	$< 25\%$ cover of overstory trees and evidence of wood cutting (e.g., wood and brush piles, stumps) within the last 5 years.
Selective cutting	$\geq 25\%$ cover of overstory trees and evidence of wood cutting (e.g., wood and brush piles, stumps) within the last 5 years.

5.0 SAFETY ISSUES

Strict safety protocols (Table A-7) will be followed while crews are in the field.

5.1 Personnel

Each crew will be provided with a first aid kit, a fire extinguisher, information regarding Lyme's disease, and a mobile telephone. Crews will wear personal flotation devices while in the canoes and will not go out on the water if conditions appear dangerous (e.g., large waves, heavy winds, storm-front moving in). Crews will be required to call the UMO Wildlife Department every day and report where they are and the lakes they plan to survey during the next three days. There will be a person in the UMO Wildlife Department specifically hired to receive these daily calls and to check off lakes as the crews complete them.

5.2 Data

Data sheets from each lake will be photocopied and the copies mailed to the UMO Wildlife Department within three days of visiting that lake. The same person who takes the phone calls at UMO will also keep track of which data sheets have been received.

TABLE A-6. CODES USED TO RECORD WIND AND SKY CONDITIONS.

Weather Variable	Scale	Description of Condition
Wind	Beaufort	
	0	smoke rises vertically
	1	wind direction shown by smoke drift
	2	wind felt on face; leaves rustle
	3	leaves, small twigs in constant motion; light flag extended
	4	raises dust and loose paper; small branches are moved
Sky	5	small trees in sway; white caps on lakes
	Sky code (eighths)	
	0	clear or few clouds
	1	partly cloudy (scattered) or variable sky
	2	cloudy (broken) or overcast
	4	fog or smoke
	5	drizzle
	8	showers

TABLE A-7. SAFETY PROTOCOL

-
1. Check weather conditions the day before and the morning of the scheduled survey to determine if weather will be hazardous to canoe travel. If thunderstorms or other unsafe weather conditions are predicted for the early morning, the team will have to decide if they can complete the survey prior to the onset of bad weather.
 2. When traveling in the canoe all individuals will wear life preservers.
 3. A fire extinguisher will be carried when using the motorized canoes
 4. A checklist of equipment will be reviewed every morning prior to launching the canoe.
 5. Each crew will contact the Wildlife Department every day to notify people of their location, any problems, and itinerary for the next 3 days.
 6. An extra spark plug and the tools needed to change the plug will be carried in the canoe when the motor is being used.
 7. The fuel tank level will be checked prior to every use to ensure adequate fuel supply for that particular survey.
 8. Refer to Lyme disease information sheet that will be provided for precautions to be taken regarding that.
 9. Flight safety protocol will include checking to see if the pilot and plane is OAS certified, that a flight plan has been filed, and the weights of all gear should be provided to the pilot so that he can properly place everything. No synthetic clothing should be worn to decrease severity of burns that could occur in a crash.
 10. Follow precautions that will be provided while using the cellular phone.
 11. To guard against loss of data, data sheets will be photocopied and the photocopies will be mailed to the UMO Wildlife Department every three days.
-

NOTICE

This research has been funded wholly or in part by the U.S. Environmental Protection Agency through its Office of Research and Development (ORD) and was conducted with research partners under the management of the Western Ecology Division, Corvallis, Oregon, the Characterization Research Division, Las Vegas, Nevada, and the Ecological Exposure Research Division, Cincinnati, Ohio under the following contracts and cooperative agreements:

Contract 68-C0-0049 to Lockheed Environmental Systems and Technologies Co., Inc.

Contract 68-C8-0006 to ManTech Environmental Technology, Inc.

Contract 68-C1-0022 to Technology Applications, Inc.

Cooperative Agreements CR818606 and CR816721 to Oregon State University

Cooperative Agreements CR819658 and CR818179 to the University of Maine-Orono

Cooperative Agreement CR814701 to the University of Nevada-Las Vegas

Cooperative Agreement CR818707 to Queens University

Cooperative Agreement CR819689-01-0 to Dartmouth College

The correct citation for this document is:

Baker, John R., David V. Peck, and Donna W. Sutton (editors). 1997. Environmental Monitoring and Assessment Program Surface Waters: Field Operations Manual for Lakes. EPA/620/R-97/001. U.S. Environmental Protection Agency, Washington, D.C.

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ACKNOWLEDGMENTS

In any undertaking with a scope as broad as that of EMAP-Surface Waters, many individuals contribute in important ways not reflected by authorship on documents such as this. This is especially true of the contents of this manual which are the product of tests and lessons learned over a period of 5 years of field work. Rather than attempt to list all of these contributors, and risk omitting some, we will identify the organizations whose staff members participated in the development of the material presented in this manual:

- EMAP-Surface Waters and associated laboratory staff in Corvallis, Las Vegas, and Cincinnati, including EPA and on-site contractor personnel (ManTech Environmental Technology, Inc., Lockheed Environmental Systems & Technologies Company, and Technology Applications, Inc.).
- Environmental Services Division of EPA Regions 1 and 2.
- Personnel on cooperative agreements with Oregon State University, Queens University, Dartmouth College, University of Maine, the University of Nevada at Las Vegas, and the Aquatic Resources Center.
- Members of the lake sampling crews of miscellaneous origin.
- Members of the peer review panel and reviewers of this manual.

Wes Kinney of the EPA in Las Vegas, made significant contributions as the Work Assignment Manager from 1991 through 1994 as well as the lead scientist for the benthic invertebrate indicator. We especially appreciate the members of the sampling crews for their diligent efforts in testing these procedures and in obtaining data of outstanding quality. The following people provided official technical reviews of this manual: B. Baldigo (U.S. Geological Survey), J. Kurtenbach (U.S. EPA), and S. Cline (U.S. EPA). Many others provided informal but important review comments. The Michigan Sea Grant Program kindly provided the drawings of zebra mussels used in Figure 8-6.

ACRONYMS AND ABBREVIATIONS

BPI	Best Professional Judgment
DLGs	Digital Line Graphs
DO	dissolved oxygen
EMAP	Environmental Monitoring and Assessment Program
EPA	U.S. Environmental Protection Agency
GPS	Global Positioning System
GQ	geometric quality
ID	identification
ORD	Office of Research and Development
OSHA	Occupational Safety and Health Administration
P-Hab	physical habitat
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
SQ	signal quality
STARS	Sample Tracking and Reporting System
T	Top
TIME	Temporally Integrated Monitoring of Ecosystems
USGS	United States Geological Survey
YOY	young of year
YSI	Yellow Springs Instrument system

Measurement Units

ha	hectare
m	meter
ppm	parts per million